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ESTIMATE OF THE PERCEPTIVE LOAD BY VARIABILITY OF RATE OF HEART--ETC(U)  
JUL 77 R AUFFRET, H SERIS, A BERTHOZ

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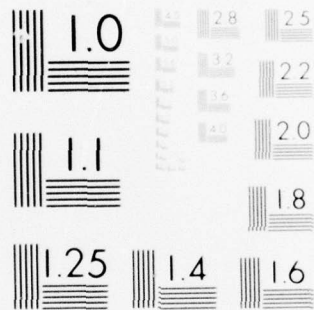
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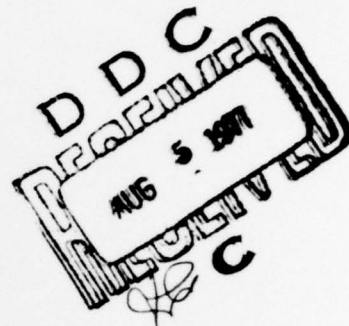
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ESTIMATE OF THE PERCEPTIVE LOAD BY VARIABILITY  
OF RATE OF HEARTBEAT. APPLICATION TO A PILOTING TASK

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The load undergone by a subject during aeronautical work is essentially perceptive. Its estimate is necessary for the human factor engineering study of an operation station. With this goal in mind and subsequent to the works by Kalsbeck, Pin and Pottier, Distel and Angiboust, we have studied the rate of pulse beat and its variability. Furthermore, this method does not degrade the performances of the subject.

Two types of testing were carried out:

In flight, tests on the help given the pilot by a data synthesizer intended for instrument (blind) landings;

On the ground, pursuit task by compensating the spot of one oscilloscope.

Starting from the steep front made up by the QR wave of the electrocardiogram, we produce time ticks which trigger a time base whose voltages are proportional to the period.

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When  $T_n$  is the time of appearance of the  $n$ th pulse, we then have:

$$\text{Cardiac period: } T_n = t_n - t_{n-1}$$

$$\text{Cardiac frequency: } F_n = (1/T_n) \times 60 \text{ in pulses per minute}$$

$$\text{Cardiac variability: } V_n = T_n - T_{n-1}$$

The automatic processing of the data gives:

The frequency and variability for each beat;

The mean values, standard deviations and other statistical magnitudes by groups of five or 40 successive beats.

These measurements and calculations have led to the following observations:

In flight as well as on the ground, there is a relationship between the psychomotor workload and cardiac arrhythmia at rest becomes less as the mean frequency at rest increases. In the case of subjects with a high frequency, the fluctuations of the

\* Numbers in the right margin indicate pagination in the original text.

\*\*Société d'Ergonomie de Langue Française, Le Travail Humain, Vol. XXX, No. 3-4, 1967, pp. 309-310

arrhythmia are therefore less apparent but remain nonetheless significant;

A blockage of respiration or a change in pulse rate is in relation to the modifications of the arrhythmia.

The measurement of the variability of the instantaneous cardiac frequency appears a useful criteria in view of the computation of the load or the detection of the variations of load during a work which is predominantly perceptive in nature. The data reduction should be carried out with a minimum accuracy of 5 ms. The fact of establishing means over too long time periods can mask out modifications in variability.

The variability appears to us to be a criterion superior to the increase in frequency because it is more comprehensive since it decreases as a function of the load even if the frequency has not varied.



